

U. S. Nanotechnology Networks

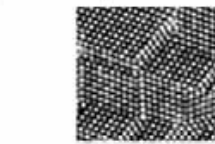
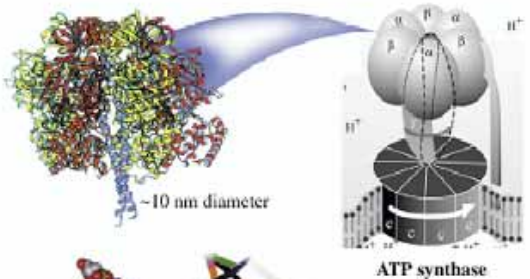
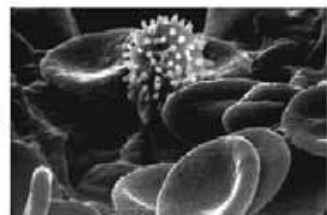
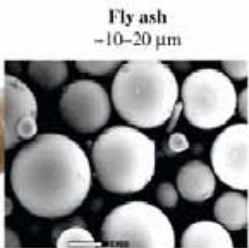
Richard W. Siegel

*Rensselaer Nanotechnology Center
Rensselaer Polytechnic Institute*

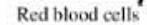
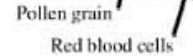
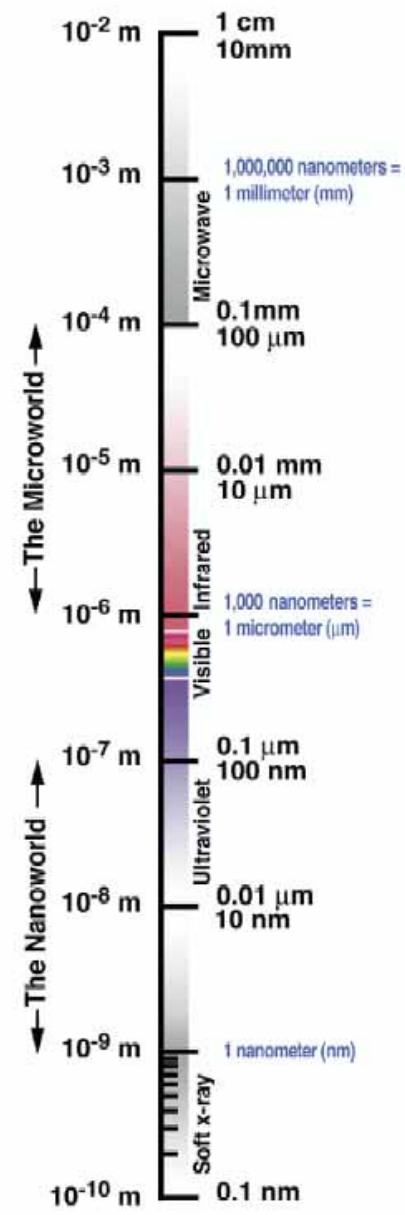


Nanotechnology Networking and International Cooperation
IUMRS-ICAM, Yokohama, Japan

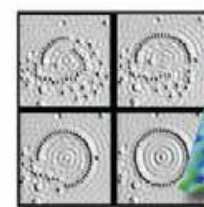
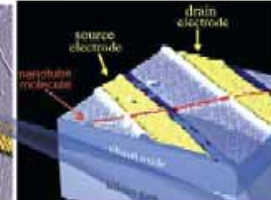
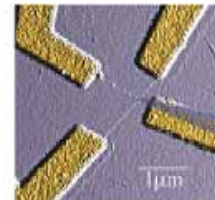
11 October 2003



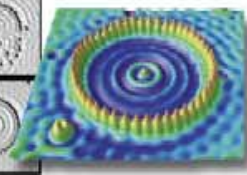
Spacing: a few tenths of a nanometer



Zone plate X-ray "lens"
Outermost ring spacing
~35 nm



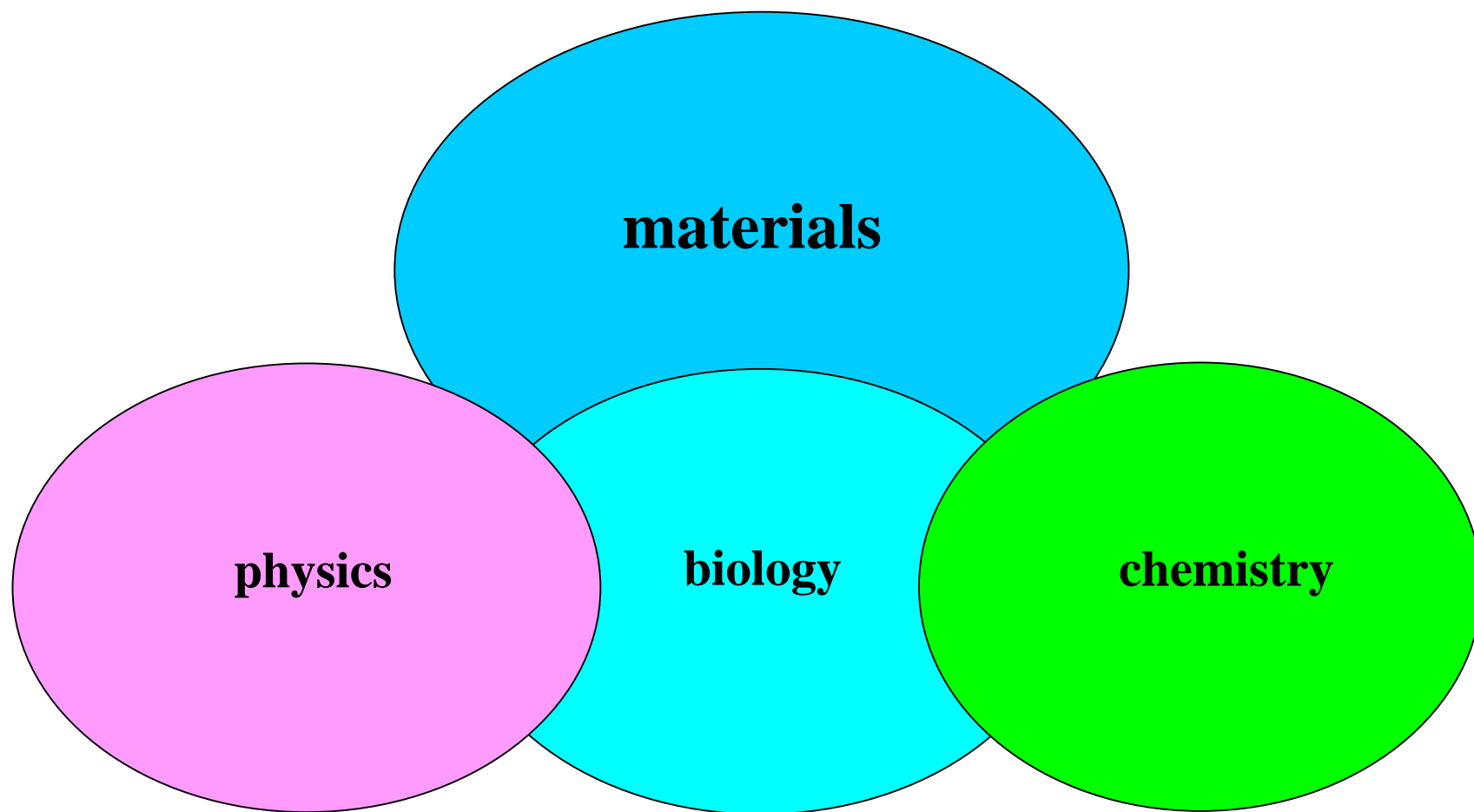
Quantum corral of 48 iron atoms on copper surface
positioned one at a time with an STM tip
Corral diameter 14 nm



Carbon nanotube
~2 nm in diameter



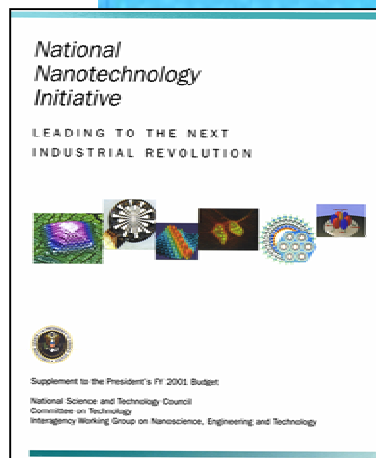
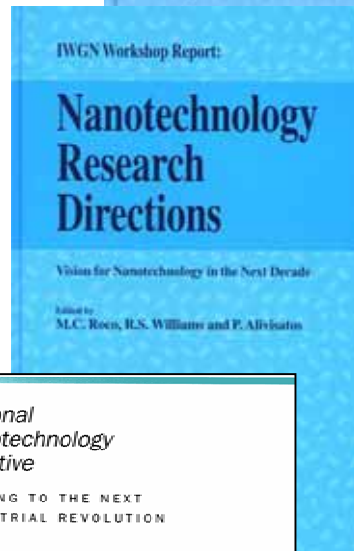
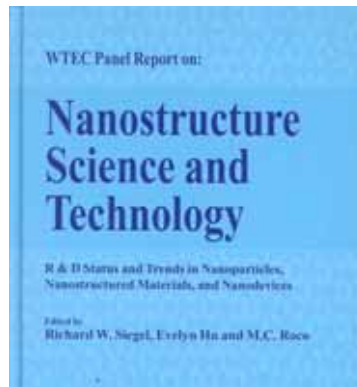
The Materials World



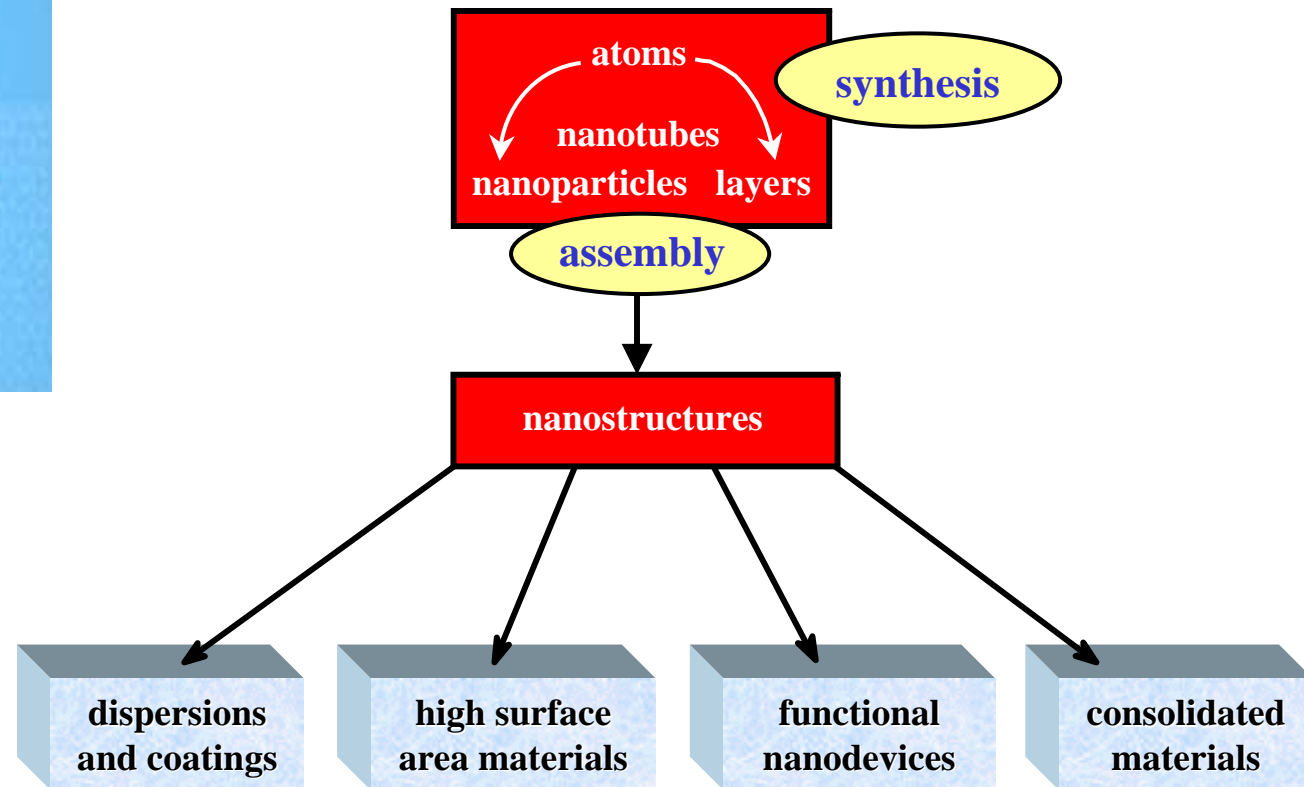
“Those who control materials control technology”

Eiji Kobayashi, Panasonic

... toward a U.S. National Nanotechnology Initiative



nanoscale building blocks



applications in our macroscopic world



<http://www.nano.gov/>

U.S. Federal R&D Investments in the National Nanotechnology Initiative

FY 2001†	\$464 million
FY 2002†	\$604 million (+30%)
FY 2003†	\$774 million (+28%)
FY 2004††	\$849 million (+10%)

† appropriated

†† requested

FY 2003 and 2004 investments

(in \$ millions)

NNI Agencies	2003	2004
NSF	221	249
DOD	243	222
DOE	133	197
NIH	65	70
NIST	69	62
NASA	33	31
Agriculture	1	10
EPA	6	5
DHS	2	2
Justice	1	1
TOTAL	774	849

Federal nanotechnology investment is currently divided into five categories

- Fundamental research (~ \$228 million '03)
- Grand Challenges (~ \$267 million)
- Research Infrastructure (~\$100 million)
provide basic tools for research, i.e. new tools and software, and the physical infrastructure, including central user facilities
- Centers of Excellence (~ \$108 million)
large group research and education activities
- Societal Implications, education, workforce training (~ \$16 million)

Current grand challenges

- Advanced chem/bio/rad and explosives detection
- Manufacturing at the nanoscale
- Nanoscale instrumentation and metrology
- Nanostructured materials by design
- Nano-electronics, -photonics and -magnetics
- Healthcare, therapeutics and diagnostics
- Energy conversion and storage
- Microcraft and robotics
- Nanoscale processes for environmental improvement

***U.S. Department of Energy
Office of Basic Energy Sciences***

Argonne National Laboratory

Center for Nanoscale Materials

Advanced Photon Source

Intense Pulsed Neutron Source

Electron Microscopy Center for Materials Research

Lawrence Berkeley National Laboratory

Molecular Foundry

Advanced Light Source

National Center for Electron Microscopy

National Energy Research

Scientific Computing Center

Nanowriter

Brookhaven National Laboratory

Center for Functional Nanomaterials

National Synchrotron Light Source

Laser-Electron Accelerator Facility

Electron Microscopy Facility

**Sandia National Laboratories and
Los Alamos National Laboratory**

Center for Integrated Nanotechnologies

Compound Semiconductor Research Laboratory

Microelectronics Development Laboratory

Combustion Research Facility

Los Alamos Neutron Science Center

National High Magnetic Field Laboratory

High-Performance Computing

Oak Ridge National Laboratory

Center for Nanophase Materials Sciences

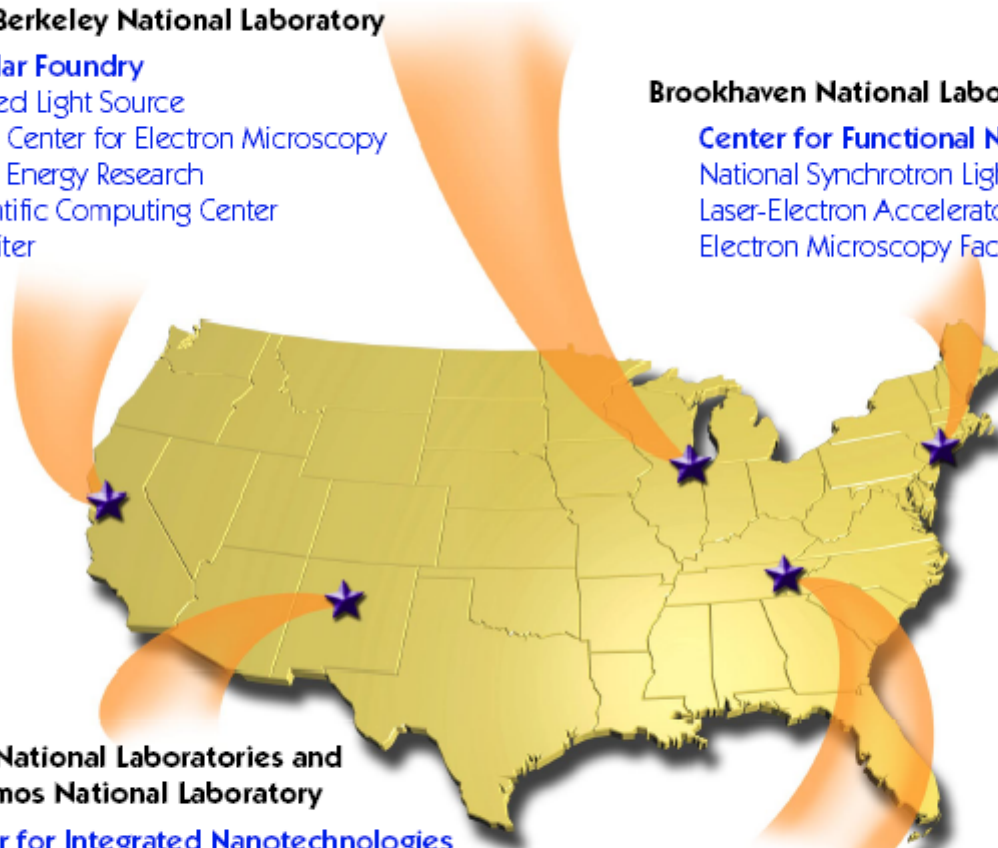
Spallation Neutron Source

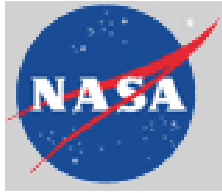
High Flux Isotope Reactor

Center for Computational Sciences

High Temperature Materials Laboratory

Shared Research Equipment Program





NASA - University Research Education Technology Institute (URETI)



University of California - Los Angeles

Center for Cell Mimetic Space Exploration

Collaborators: California Institute of Technology, Arizona State

(Chih-Ming Ho, Director)



Princeton University

Bio-Inspired Design and Processing of Multi-Functional Nano-Composites

Collaborators: Univ. of Calif.-Santa Barbara, Northwestern, Univ. of North Carolina, ICASE

(Ilhan Aksay, Director)



Texas A&M University

Institute for Intelligent Bio-Nano Materials and Structures for Aerospace Vehicles

Collaborators: Rice Univ., Texas Southern, Prairie View A&M, Univ. of Texas-Arlington

(John Junkins, Director)



Purdue University

Institute for Nanoelectronics and Computing

Collaborators: Yale, Northwestern, Univ. of Florida, Cornell, Univ. of Calif.-San Diego

(Supriyo Datta, Director)



National Science
Foundation

Nanoscale Science and Engineering Centers



NORTHWESTERN
UNIVERSITY

Integrated Nanopatterning and Detection Technologies
Northwestern University (*Chad A. Mirkin, Director*)



Nanoscience in Biological and Environmental Engineering
Rice University (*Vicki Colvin, Director*)



HARVARD UNIVERSITY

Nanoscale Systems and Their Device Applications
Harvard University (*Robert M. Westervelt, Director*)



Electron Transport in Molecular Nanostructures
Columbia University (*James T. Yardley, Director*)



Nanoscale Systems in Information Technology
Cornell University (*Robert A. Buhrman, Director*)



Directed Assembly of Nanostructures
Rensselaer Polytechnic Institute (*Richard W. Siegel, Director*)



Nanoscale Science and Engineering Center for Directed Assembly of Nanostructures

www.rpi.edu/dept/nsec

K-12 Programs
Undergraduate Colleges
Morehouse
Mount Holyoke
Smith
Spelman
Williams
Distance-learning
Visiting Researchers

Education

Industry

Industry Partners

ABB
Albany International
IBM
Eastman Kodak
Philip Morris
New York State



**Rensselaer
Polytechnic Institute**



**University of Illinois
at Urbana-Champaign**

**RPI
and
UIUC**

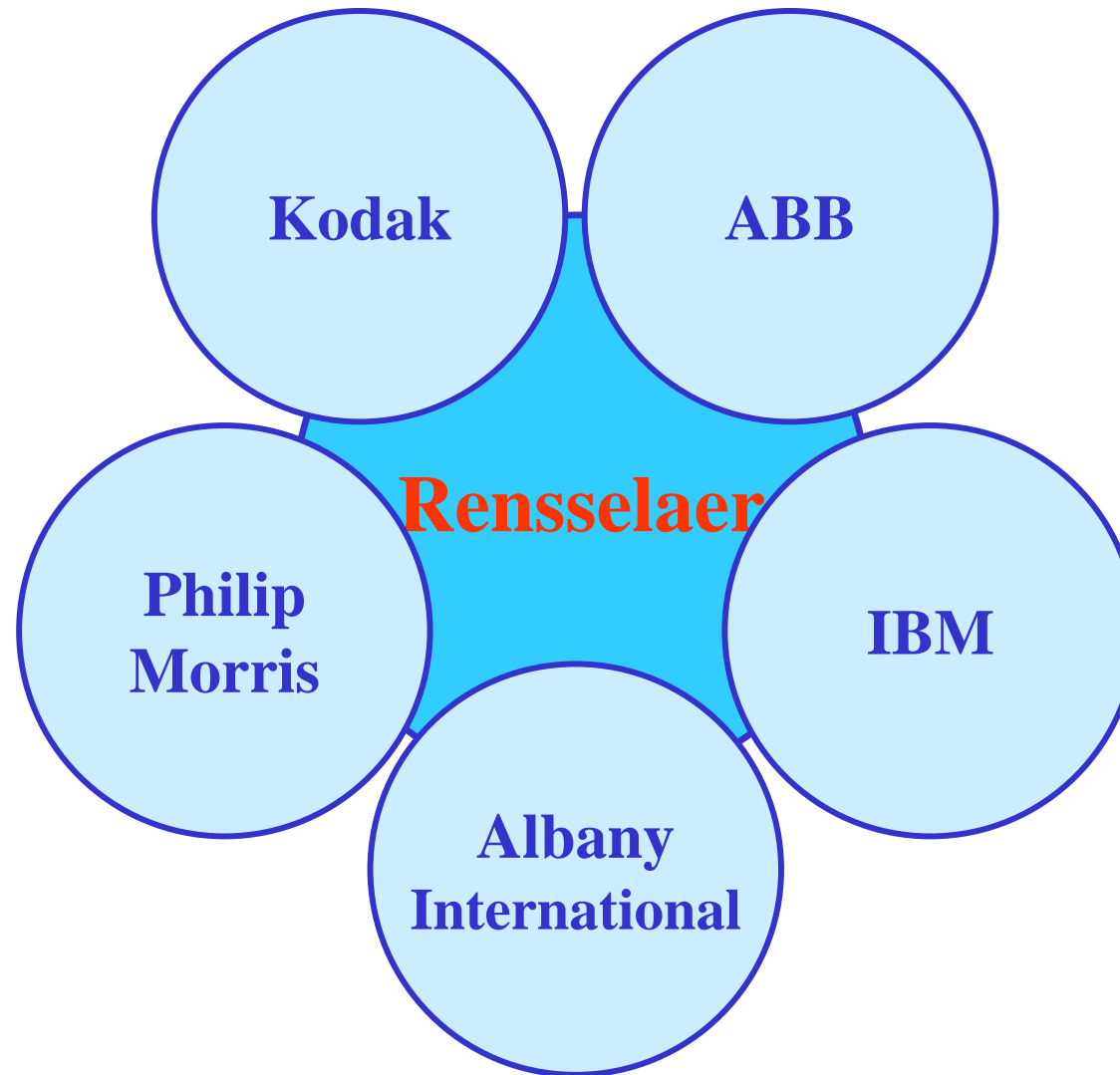
LANL



Founded September 2001



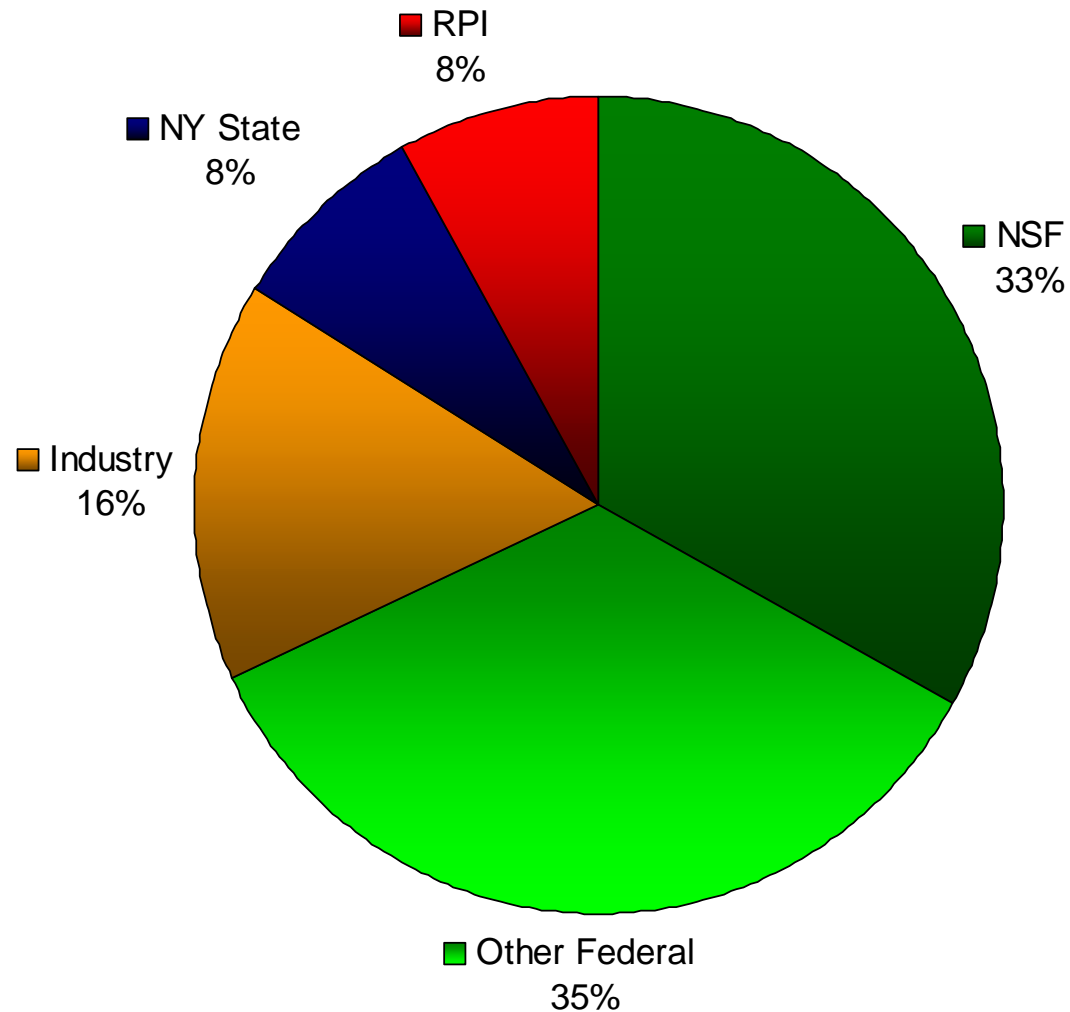
Rensselaer-Industry Partnership

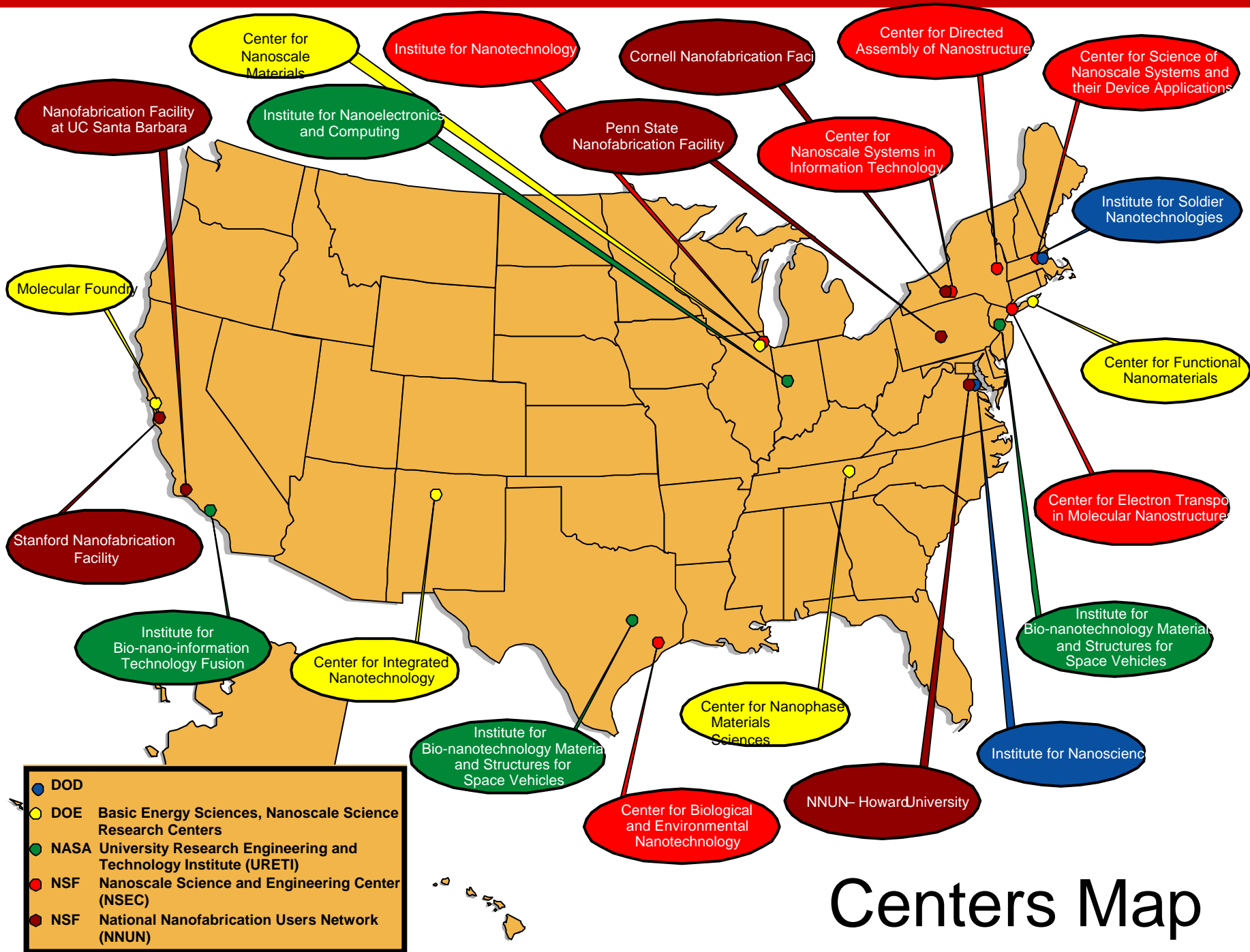


Established 1999 -2000

Sources of Funding in the Rensselaer Nanotechnology Center

annual funding ca. \$6 million





Centers Map